TiCN BASED CERMET

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PURPOSE:To provide a TiCN based cermet having remarkably improved chipping resistance and wear resistance.
CONSTITUTION:The TiCN based cermet comprises the cored-structural hard phase grains 1 having a cored structure which consists of the core part 5 contg. Ti and N abundantly and the outer peripheral part 6 contg. W, Nb and C, the non cored-structural hard phase grains 3 not having any cored structure and the binding phase 2. Preferably in particular, of the total hard phase grains, the volume ratio of the non-cored-structural hard phase grains 3 having <=1mum crystalline grain size is >=1vol.% of the total, and the average crystalline grain size of the cored structural hard phase grains 1 is >=1mum, and also the average crystalline grain size of the non-cored-structural hard phase grains 3 is <=0.5mum.

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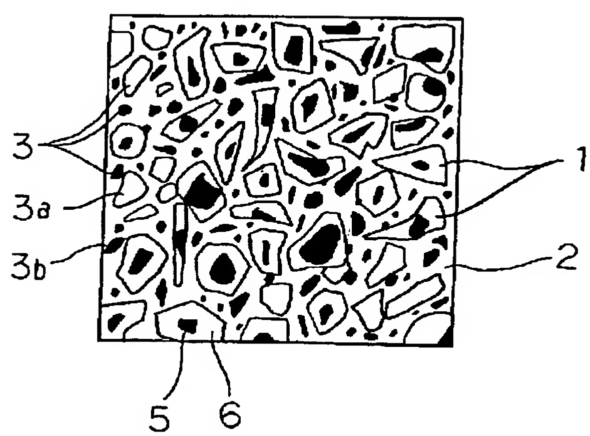
(54)【発明の名称】　ＴｉＣＮ基サーメット

(57)【要約】
【目的】耐欠損性，耐摩耗性を大幅に向上することができるＴｉＣＮ基サーメットを提供する。
【構成】ＴｉおよびＮに富む芯部５とＷ，ＮｂおよびＣを含有する外周部６とからなる有芯構造を呈する有芯構造硬質相粒子１と、有芯構造を呈さない非有芯構造硬質相粒子３と、結合相２とからなるＴｉＣＮ基サーメットであって、全硬質相粒子のうち結晶粒径が１μm以下の非有芯構造硬質相粒子３の占める割合が１体積％以上であるもので、有芯構造硬質相粒子１の平均結晶粒径が１μm以上であり、非有芯構造硬質相粒子３の平均結晶粒径が０．５μm以下であることが特に好ましい。



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【特許請求の範囲】

【請求項1】ＴｉおよびＮに富む芯部とＷ，ＮｂおよびＣを含有する外周部とからなる有芯構造を呈する有芯構造硬質相粒子と、有芯構造を呈さない非有芯構造硬質相粒子と、結合相とからなるＴｉＣＮ基サーメットであって、全硬質相粒子のうち結晶粒径が1μm以下の非有芯構造硬質相粒子の占める割合が1体積％以上であることを特徴とするＴｉＣＮ基サーメット。

【請求項2】有芯構造硬質相粒子の平均結晶粒径が1μm以上であり、非有芯構造硬質相粒子の平均結晶粒径が０．５μm以下である請求項1記載のＴｉＣＮ基サーメット。

【請求項3】全体組成から鉄族金属および不可避不純物を除く他の成分組成を〔(Ｔｉ)a (Ｎｂ)b (Ｗ)c〕(Ｃu Ｎv) z と表した時、ａ＋ｂ＋ｃ＝１、０．５０≦ａ≦０．９５、０．０５≦ｂ＋ｃ≦０．５０、０＜ｂ／ｂ＋ｃ≦０．９５、０．４０≦ｖ≦０．６０、０．８０≦ｚ≦１．００、ｕ＋ｖ＝１を満足する請求項1または2記載のＴｉＣＮ基サーメット。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、耐欠損性，耐摩耗性に優れたＴｉＣＮ基サーメットに関し、特に切削工具材料として用いた場合、湿式切削性能に優れるＴｉＣＮ基サーメットに関する。

【０００２】

【従来技術】近年、切削工具材料，耐摩耗工具材料などに周期律表第４ａ，５ａ，６ａ族元素の複炭窒化物からなる硬質相と、鉄族金属からなる結合相によって構成されるサーメットが広く用いられるようになった。

【０００３】かかるサーメットとしては、これまでＴｉＣを主成分とするＴｉＣ基サーメットが主流であったが、このＴｉＣ基サーメットが古くから工具材料として用いられていた超硬合金に比較して靭性が劣るために、この系に窒化物を添加することにより靭性を改善したいわゆるＴｉＣＮ基サーメットが提案された。

【０００４】このＴｉＣＮ基サーメットの代表例として特公昭５６－５１２０１号が挙げられ、ここでは、（Ｔｉ，Ｗ，Ｔａ，Ｍｏ）ＣＮからなる硬質相と、Ｎｉ，Ｃｏからなる結合相とから構成されるサーメットが開示され、硬質相がＴｉや窒素に富む芯部と、Ｗ，Ｔａ，Ｍｏおよび炭素に富む周辺部とから構成された有芯構造を呈することが述べられている。

【０００５】また、硬質相を形成する炭素（Ｃ）および窒素（Ｎ）はサーメットの靭性および硬度を決定する大きな要因であり、最近では窒素を多量に含有させることによりサーメットの靭性を高めようとする試みもなされている。

【０００６】ところが、最近に至り上記のＴｉＣＮ基サーメットに対してその表面部の組織を変えることにより耐摩耗性や靭性をさらに高めようといった改良がなされている。例えば特公昭５９－１４５３４号公報では、焼成時に液相出現温度以下で窒素を炉内に導入することによって焼結体表面に靭性に富む軟化層を形成することが、また特公昭５９－１７１７６号公報では、焼成をＣＯを含む還元雰囲気内で行うことにより内部より高硬度の層を形成することが提案されている。

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【０００７】

【発明が解決しようとする問題点】しかしながら、これらの先行技術は、いずれも硬度あるいは靭性のどちらかのみ検討するにとどまり、使用温度，雰囲気，熱衝撃など年々厳しくなる使用条件を満たすのには不十分となりつつあった。特に熱衝撃，機械的衝撃に関する問題では、使用中に損傷が生じたり、また、最悪の場合、欠損を引き起こし使用不能になることがある。これは主として従来のサーメットが超硬合金に比べて耐熱衝撃性，耐欠損性に劣るためであると考えられる。

【０００８】

【問題点を解決するための手段】本発明者は、上記の問題点に対して検討を行った結果、サーメット組織内にいわゆる非有芯構造硬質相粒子を１体積％以上分散させることにより、サーメットの耐熱衝撃性，耐欠損性，さらに耐摩耗性を改善できることを知見し、本発明に至った。

【０００９】即ち、ＴｉおよびＮに富む芯部とＷ，ＮｂおよびＣを含有する外周部とからなる有芯構造を呈する有芯構造硬質相粒子と、有芯構造を呈さない非有芯構造硬質相粒子と、結合相とからなるＴｉＣＮ基サーメットであって、全硬質相粒子のうち結晶粒径が１μm以下の非有芯構造硬質相粒子の占める割合が１体積％以上であることを特徴とする。ここで、有芯構造硬質相粒子の平均結晶粒径が１μm以上であり、非有芯構造硬質相粒子の平均結晶粒径が０．５μm以下であることが最適である。また、組成上は、全体組成から鉄族金属および不可避不純物を除く他の成分組成を〔(Ｔｉ)a (Ｎｂ)b (Ｗ)c〕(Ｃu Ｎv) z と表した時、ａ＋ｂ＋ｃ＝１、０．５０≦ａ≦０．９５、０．０５≦ｂ＋ｃ≦０．５０、０＜ｂ／ｂ＋ｃ≦０．９５、０．４０≦ｖ≦０．６０、０．８０≦ｚ≦１．００、ｕ＋ｖ＝１を満足するものである。

【００１０】以下、本発明を詳述する。

【００１１】本発明のＴｉＣＮ基サーメットは、基本的に硬質相と結合相から構成されるものであるが、本発明において、サーメット組織内には、非有芯構造硬質相粒子を分散含有する。即ち、サーメット組織中には、図１に示すように、平均結晶粒径１μm以上の有芯構造硬質相粒子１が結合相２中に分散しており、さらに、粗粒の有芯構造硬質相粒子１間に微粒の非有芯構造硬質相粒子３が分散した構造となっている。

【００１２】そして、全硬質相粒子のうち結晶粒径が１

μm以下の非有芯構造硬質相粒子が１体積％以上の割合で含有される。結晶粒径１μm以下の非有芯構造硬質相粒子の占める割合を１体積％以上含有させたのは、１体積％よりも少ないと、微粒の非有芯構造硬質相粒子の分散による結合相の強化の効果が少なく、耐摩耗性や耐欠損性が向上しないからである。結晶粒径が１μm以下の非有芯構造硬質相粒子の占める割合は５０体積％以下であることが望ましい。５０体積％よりも多いと微粒子中に粗粒子が点在する形となり、耐欠損性が低下するためである。この非有芯構造硬質相粒子は、特に２～５体積％含有することが好ましい。このような非有芯構造硬質相粒子の占める割合は、少なくともサーメット表面から深さ２００μmまでの位置に１体積％存在すれば良い。また、非有芯構造硬質相粒子はサーメット内部よりも表面に多く存在する。

【００１３】有芯構造硬質相粒子は、図１に示したように、ＴｉおよびＮに富む芯部５と、Ｗ，ＮｂおよびＣを含有する外周部６とから構成されている。また、白く表現した図１の非有芯構造硬質相粒子３ａは、Ｔｉ，Ｃ，Ｎ粒子にＷおよびＮｂが固溶して構成されており、黒っぽく表現した図１の非有芯構造硬質層粒子３ｂは、Ｔｉ，ＮおよびＣを含有する粒子である。

【００１４】また、有芯構造硬質相粒子の平均結晶粒径を１μm以上とし、非有芯構造硬質相粒子の平均結晶粒径を０．５μm以下としたのは、有芯構造硬質相粒子の平均結晶粒径が１μmよりも小さく、非有芯構造硬質相粒子の平均結晶粒径が０．５μmよりも大きいと、組織を構成する粒子が平均化して耐欠損性が低下するからである。有芯構造を呈する硬質相粒子の平均結晶粒径は、特に１．２～３μm、有芯構造を呈さない硬質相粒子の平均結晶粒径は０．０５～０．４μmとすることが好ましい。

【００１５】また、組成を前述したように構成したのは、硬質相を形成する主成分であるＴｉは、焼結体内におよそＴｉＣＮとして存在し、その量はサーメットの強度や硬度を決定する大きな要因となっている。このＴｉ量（ａ）が前記式において０．５より少ないと耐摩耗特性が不十分であり、０．９５を越えると耐欠損性に劣る。Ｔｉ量（ａ）は０．７０≦ａ≦０．９０であることが特に望ましい。

【００１６】サーメットにおいて、Ｔｉと同様に必須の成分とされるＷはＷＣとして硬質相の結合相との濡れ性を改善するとともに粒成長を抑え、強度，靭性を高める作用をなすが、硬質相が（Ｔｉ，Ｗ）ＣＮから構成される場合は、耐摩耗性，耐酸化性，耐欠損性等の特性が実用的レベルに達していないという問題がある。そこで、硬質相を強化し諸特性を向上することを目的として、これまでＭｏやＴａ等の炭化物が必須の成分として使用されたが、Mo_2Ｃ自体、硬質相主成分であるＴｉＣあるいはＴｉＣＮに比較して特性が劣るために、逆にサーメットの特性向上には大きく寄与せず、場合によっては特性を劣化させてしまうという傾向にあることがわかった。特に、この傾向は熱衝撃を伴う使用環境下で顕著であった。

【００１７】そこで、Mo_2Ｃに代わる成分として、Ｎｂの炭化物がMo_2Ｃに比較してそれ自体優れた特性を有することにより、サーメットの特性、特に耐熱衝撃性を大きく改善でき、耐摩耗特性，耐欠損性を向上することができる。よって、本発明の構成においてＮｂとＷとの合量（ｂ＋ｃ）が０．０５より少ないと耐熱衝撃性が不十分となり、０．５より大きいと耐摩耗性が劣るとともに被削材との反応性が高くなる傾向にある。（ｂ＋ｃ）値は０．１０≦ｂ＋ｃ≦０．３０であることが特に望ましい。

【００１８】また、Ｗ，Ｎｂの合量（ｂ＋ｃ）に対するＮｂ量（ｂ）の割合（ｂ／ｂ＋ｃ）が０であると耐摩耗性，耐酸化性が劣下し、逆に０．９５より大きいと耐欠損性が低下する。（ｂ／ｂ＋ｃ）値は、０．３≦ｂ／ｂ＋ｃ≦０．７であることが特に望ましい。

【００１９】本発明におけるサーメットによれば、前記理由からＭｏの添加はむしろ避けるべきでその量はサーメット中０．５重量％以下にすることが望ましい。一方、窒素および炭素の量はサーメットの硬度，耐熱衝撃性，靭性を決定する要因として重要であり、特に窒素の量が増加するに従い靭性が向上する傾向にあるが、窒素の量が過多になると焼成時の窒化物の分解によるガスがボイドとして焼結体中に残留するという問題が生じる。よって前記式において窒素量（ｖ）が０．４より小さいと、靭性が低下し耐欠損性が不十分となり、０．６を越えると焼結体内にボイドが発生し信頼性に欠けるようになる。窒素量（ｖ）は、０．４≦ｖ≦０．５５であることが特に望ましい。

【００２０】また、窒素、炭素量のＴｉ，Ｗ，Ｎｂの合量に対する比率（ｚ）が０．８より小さいと焼結性が劣化しボイドが残留し、１．０より大きいと遊離炭素が発生するために強度低下を引き起こす結果となる。望ましくは０．８５≦ｚ≦１．０である。

【００２１】本発明において結合相を形成する鉄族金属としては、Ｎｉおよび／またはＣｏが挙げられ、望ましくはＮｉとＣｏから構成され、特にＣｏ／Ｎｉ＋Ｃｏのモル比が０．５～０．９であることが耐摩耗性向上の点からよい。また、この鉄族金属は系中において３～３０重量％、特に５～２０重量％の割合で存在することが望ましい。

【００２２】上記の本発明のサーメットを製造するための方法としては、例えば、まず前述したＴｉ，Ｗ，Ｎｂの炭化物，窒化物，炭窒化物の粉末および鉄族金属粉末を最終焼結体が上述した割合に成るように秤量混合した後にプレス成形，押し出し成形，射出成形等の成形手段で成形後、焼成する。

【0023】焼成は、真空中、あるいは還元性雰囲気中で1400～2000℃の温度で行う。焼結中の任意の温度において、N，CO，Ar，Heなどのガスを0～760Torr導入して雰囲気調整を行うこともある。

【0024】また、本発明によれば、上記（Ti，W，Nb）（C，N）、鉄族金属からなる系に対して特性を改善する目的でさらにZr，Hf，Cr，TaおよびV等の炭化，窒化物，炭窒化物等を添加し、TiあるいはNbの一部を置換することにより特性の改善を図ることができ、特にNbの一部をVで置換することによりNbの作用効果をさらに助長し、特に切削工具として用いた場合、サーメットの湿式切削性を大きく向上することができる。なお、Nb／Vの原子比は0．5～10、特に1～6であることが望ましい。

【0025】本発明のTiCN基サーメットは、さらに周知の方法により単層または複層の硬質被覆層を形成しても良い。被覆される硬質被覆層としては、周期律表第4a，5a，6a族元素およびホウ素（B），アルミニウム（Al）から選ばれる1種または2種以上の金属の炭化物，窒化物，炭窒化物，酸化物，炭酸化物，酸窒化物，炭酸窒化物があり、これらは0．1～10μmの厚みでCVD法またはPVD法等により形成される。このように表面を特定の材料で被覆することにより、耐摩耗性，耐欠損性を向上することが可能となり、工具として＊用いた場合に、性能を大幅に向上することができる。

【0026】

【作用】本発明のTiCN基サーメットでは、有芯構造硬質相粒子が結合相中に分散しており、さらに、粗粒の有芯構造硬質相粒子間に結晶粒径が1μm以下の微粒の非有芯構造硬質相粒子が1体積%以上分散した構造となっているため、特に結合相が強化されて耐欠損性が向上する。

【0027】また、有芯構造硬質相粒子の平均結晶粒径を1μm以上とし、非有芯構造硬質相粒子の平均結晶粒径を0．5μm以下とすることにより、耐欠損性，耐摩耗性をさらに大幅に向上することが可能となる。

【0028】以下、本発明を次の例で説明する。

【0029】

【実施例】原料粉末としてTiC，TiCN，WC，NbC，Ni，Coの各粉末を用いて最終焼結体の組成が表1の割合に成るように秤量混合した後、1．5ton／cm² の圧力でCNMG120408用のチップ形状にプレス成形し、1500℃の温度で真空度10^{-1}から真空度10^{-3}へ変化させて1時間焼成した。焼結体組織を図1に示す。

【0030】

【表1】

試料No.	組　　成　（鉄族金属、不純物を除く）	鉄族金属(wt%)	
		Ni	Co
1	$(Ti_{0.95}Nb_{0.025}W_{0.025})(C_{0.50}N_{0.50})_{0.9}$	4	12
2	$(Ti_{0.90}Nb_{0.07}W_{0.03})(C_{0.55}N_{0.45})_{0.9}$	4	12
3	$(Ti_{0.85}Nb_{0.12}W_{0.03})(C_{0.45}N_{0.55})_{0.9}$	4	12
4	$(Ti_{0.80}Nb_{0.15}W_{0.05})(C_{0.50}N_{0.50})_{0.9}$	3	15
5	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.45}N_{0.55})_{0.9}$	4	12
＊6	$(Ti_{0.85}Nb_{0.07}W_{0.08})(C_{0.55}N_{0.45})_{0.9}$	4	12
＊7	$(Ti_{0.55}Nb_{0.15}W_{0.30})(C_{0.45}N_{0.55})_{0.9}$	4	12
＊8	$(Ti_{0.50}Nb_{0.45}W_{0.05})(C_{0.55}N_{0.45})_{0.9}$	4	12
＊9	$(Ti_{0.80}Nb_{0.03}W_{0.17})(C_{0.50}N_{0.50})_{0.9}$	4	12
＊10	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.25}N_{0.75})_{0.9}$	4	12

＊印は、本発明の範囲外の試料を示す。

【0031】得られた焼結体の平均結晶粒径を、試料表面をポリッシングした後、SEM（走査型電子顕微鏡）と画像処理装置により求めた。また、結晶粒径が1μm以下の非有芯構造硬質相粒子の割合を平均結晶粒径の測定と同様にして求めた。

【0032】加工後、下記に示す切削条件で切削試験を行い、切削性能の確認を行った。試験後の逃げ面におけるフランク摩耗量と非欠損コーナー数を調べた。

（摩耗試験）

被削材　　SCM435

切削速度　２５０　m／min
切り込み　２　mm
送り　０．３　mm／rev
切削時間　１０　min
（欠損試験）
被削材　ＳＣＭ４３５　（４本溝入）
切削速度　１００　m／min
＊切り込み　２　mm
送り　０．３　mm／rev
切削時間　１　min
特性評価結果は表２に示した。

【００３３】
【表２】

試料No.	結晶粒径1μm以下の非有芯構造粒子(体積%)	有芯構造粒子の平均結晶粒径(μm)	非有芯構造粒子の平均結晶粒径(μm)	強度(kg/mm²)	硬度(kg/mm²)	靱性(MPa・m^1/2)	切削試験	
							摩耗量(mm)	耐欠損性
1	3	1.8	0.2	1820	1400	14.0	0.16	9/10
2	2	2.5	0.2	1750	1460	13.0	0.12	10/10
3	5	1.0	0.2	1770	1450	13.5	0.18	10/10
4	3	2.0	0.15	1790	1510	13.0	0.15	9/10
5	1	1.5	0.50	1800	1420	13.8	0.18	10/10
＊6	0.1以下	3.0	1.5	1620	1410	13.1	0.30	2/10
＊7	0	2.0	――	1400	1250	13.5	0.41	1/10
＊8	0	3.5	――	1350	1210	12.5	損傷大	0/10
＊9	0.3	2.5	2.0	1600	1510	10.5	0.28	2/10
＊10	0	0.9	――	1700	1580	9.2	0.25	0/10

＊印は本発明の範囲外の試料を示す。

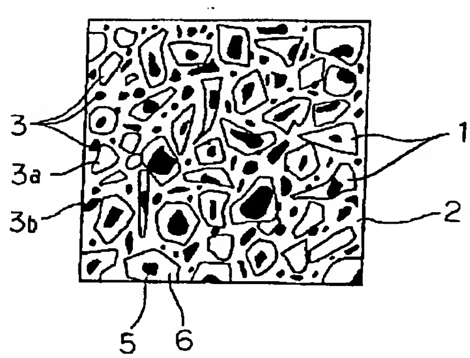
【００３４】表１および表２によれば、平均粒径１μm以下の非有芯構造硬質相粒子を組織内に１体積％以上分散したサーメットでは、耐欠損性，耐摩耗性が優れていることが判る。

【００３５】
【発明の効果】本発明のＴｉＣＮ基サーメットでは、非有芯構造硬質相粒子を１体積％以上含有したので、耐欠損性，耐摩耗性を大幅に向上することができ、これにより、工具として用いた場合に適用可能な切削条件を拡大するとともに、工具の長寿命化を図ることができる。

【図面の簡単な説明】
【図１】本発明のＴｉＣＮ基サーメットを走査型電子顕微鏡にて観察した５０００倍の模式図である。

【符号の説明】
1　有芯構造硬質相粒子
2　結合相
3　非有芯構造硬質相粒子
5　芯部
6　外周部

【図１】



DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the 5000 times as many ** type view which observed the TiCN basis cermet of this invention with the scanning electron microscope as this.
[Description of Notations]
1 Cored Structure Hard Phase Particle
2 Binder Phase
3 Coreless Structure Hard Phase Particle
5 Core Part
6 Periphery Section

[Translation done.]

OPERATION

[Function] In the TiCN basis cermet of this invention, the cored structure hard phase particle is distributing in a binder phase, since the diameter of crystal grain has further structure which the coreless structure hard phase particle of a particle 1 micrometer or less distributed more than 1 volume % between the cored structure hard phase particles of coarse grain, a binder phase is strengthened and deficit-proof nature improves.
[0027] Moreover, it becomes possible by setting the diameter of average crystal grain of a cored structure hard phase particle to 1 micrometers or more, and setting the diameter of average crystal grain of a coreless structure hard phase particle to 0.5 micrometers or less to improve deficit-proof nature and abrasion resistance still more sharply.
[0028] Hereafter, the following example explains this invention.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] this invention relates to the TiCN basis cermet which is excellent in wet cutting-ability ability, when it uses especially as a cutting tool material about the TiCN basis cermet excellent in deficit-proof nature and abrasion resistance.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In recent years, the cermet constituted by the hard phase which becomes a cutting tool material, an antifriction tool material, etc. from the double charcoal nitride of periodic-table the 4a, 5a, and 6a group element, and the binder phase which consists of an iron-group metal came to be used widely.
[0003] Although the TiC basis cermet which makes TiC a principal component until now was in use as this cermet, since toughness was inferior as compared with the cemented carbide for which this TiC basis cermet was used as a tool material for many years, the so-called TiCN basis cermet which has improved toughness was proposed by adding a nitride in this system.
[0004] JP,56-51201,B is mentioned as an example of representation of this TiCN basis cermet, the cermet which consists of a hard phase which consists of CN (Ti, W, Ta, Mo), and a binder phase which consists of nickel and Co here is indicated, and it is said that the cored structure which consisted of a core part to which a hard phase is rich in Ti or nitrogen, and a periphery which is rich in W, Ta, Mo, and carbon is presented.
[0005] Moreover, the carbon (C) and nitrogen (N) which form a hard phase are a big factor which determines the toughness and degree of hardness of a cermet, and, recently, the attempt which is going to raise the toughness of a cermet is also made by making nitrogen contain so much.
[0006] However, improvement that abrasion resistance and toughness will be raised further is made by continuing till recently and changing the organization of the surface section to the above-mentioned TiCN basis cermet. for example, the thing for which the softening layer which is rich in toughness is formed in a sintering body surface in JP,59-14534,B by introducing nitrogen in a furnace below at liquid phase appearance temperature at the time of baking -- moreover, in JP,59-17176,B, forming the layer of a high degree of hardness from the interior is proposed by performing baking within the reducing atmosphere containing CO

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] In the TiCN basis cermet of this invention, since the coreless structure hard phase particle was contained more than 1 volume %, while expanding the cutting conditions which can be applied when it can improve sharply and this uses deficit-proof nature and abrasion resistance as a tool, reinforcement of a tool can be attained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, each of these advanced technology remained for examining either a degree of hardness or toughness, and was becoming inadequate for fulfilling service conditions which become severe every year, such as a service temperature, atmosphere, and a thermal shock. On the problem especially about a thermal shock and a mechanical shock, damage arises while in use, and when the worst, a deficit is caused and there is a bird clapper impossible [use]. This is considered to be because for the conventional cermet to be mainly inferior to a thermal shock resistance and deficit-proof nature compared with cemented carbide.

[Translation done.]

MEANS

[Means for Solving the Problem] As a result of inquiring to the above-mentioned trouble, by making a cermet in-house distribute the so-called coreless structure hard phase particle more than 1 volume %, this invention person did the knowledge of being [of a cermet] the thermal shock resistance, deficit-proof being nature, and abrasion resistance being further improvable, and resulted in this invention.
[0009] That is, it is characterized by the cored structure hard phase particle which presents the cored structure which consists of a core part which is rich in Ti and N, and the periphery section containing W, Nb, and C, and the rate in which it is the TiCN basis cermet which consists of a coreless structure hard phase particle which is not, and a binder phase ****, and a coreless structure hard phase particle 1 micrometer or less occupies [the diameter of crystal grain] a cored structure among all hard phase particles being more than 1 volume %s. It is optimal that the diameter of average crystal grain of a cored structure hard phase particle is 1 micrometers or more, and the diameter of average crystal grain of a coreless structure hard phase particle is 0.5 micrometers or less here. Moreover, a composition top is [(Ti) a (Nb) b (W) c] (Cu Nv) z about other component composition except the iron-group metal from whole composition, and an unescapable impurity. When expressed, a+b+c=1, 0.50<=a<=0.95, 0.05 <=b+c<=0.50, 0<b/b+c<=0.95, 0.40<=v<=0.60, 0.80<=z<=1.00, and u+v=1 are satisfied.
[0010] Hereafter, this invention is explained in full detail.
[0011] Although the TiCN basis cermet of this invention consists of a hard phase and a binder phase fundamentally, it carries out distributed content of the coreless structure hard phase particle in this invention at a cermet in-house. That is, during the cermet organization, as shown in drawing 1 , the cored structure hard phase particle 1 of 1 micrometers or more of diameters of average crystal grain is distributing in a binder phase 2, and it has further structure which the coreless structure hard phase particle 3 of a particle distributed between the cored structure hard phase particles 1 of coarse grain.
[0012] And a coreless structure hard phase particle 1 micrometer or less contains [the diameter of crystal grain] at a rate more than 1 volume % among all hard phase particles. When fewer than 1 volume %, having made the rate for which the coreless structure hard phase particle of 1 micrometer or less of diameters of crystal grain accounts contain more than 1 volume % has few effects of strengthening of the binder phase by distribution of the coreless structure hard phase particle of a particle, and it is because neither abrasion resistance nor deficit-proof nature improves. As for the rate for which a coreless structure hard phase particle 1 micrometer or less accounts, it is desirable for the diameter of crystal grain to be below 50 volume %. When [than 50 volume %] more, it is to become the form where it is dotted with coarse grain, and for deficit-proof nature to fall into a particle. As for especially this coreless structure hard phase particle, it is desirable to do 2-5 volume % content of. What is necessary is just to do at least 1 volume % existence of the rate for which such a coreless structure hard phase particle accounts in the position from a cermet front face to a depth of 200 micrometers. Moreover, a coreless structure hard phase particle exists more mostly [a front face] than the interior of a cermet.
[0013] The cored structure hard phase particle consists of a core part 5 which is rich in Ti and N, and the periphery section 6 containing W, Nb, and C, as shown in drawing 1 . Moreover, W and Nb dissolve to Ti, C, and N particle, coreless structure hard phase particle 3a of drawing 1 expressed white is constituted, and coreless structure hard layer particle 3b of drawing 1 expressed blackly is a

**-ed material SCN435 (4 slot ON)
Cutting speed 100 It cuts deeply m/min. 2 It sends mm. 0.3 mm/rev cutting time 1 The min characterization result was shown in Table 2.
[0033]
[Table 2]

試料No.	結晶粒径1μm以下の非有芯構造粒子(体積%)	有芯構造粒子の平均結晶粒径(μm)	非有芯構造粒子の平均結晶粒径(μm)	強度(kg/mm²)	硬度(kg/mm²)	靱性(MPa・m$^{1/2}$)	切削試験	
							摩耗量(mm)	耐欠損性
1	3	1.8	0.2	1820	1400	14.0	0.16	9/10
2	2	2.5	0.2	1750	1460	13.0	0.12	10/10
3	5	1.0	0.2	1770	1450	13.5	0.18	10/10
4	3	2.0	0.15	1790	1510	13.0	0.15	9/10
5	1	1.5	0.50	1800	1420	13.8	0.18	10/10
*6	0.1以下	3.0	1.5	1620	1410	13.1	0.30	2/10
*7	0	2.0	―――	1400	1250	13.5	0.41	1/10
*8	0	3.5	―――	1350	1210	12.5	損傷大	0/10
*9	0.3	2.5	2.0	1600	1510	10.5	0.28	2/10
*10	0	0.9	―――	1700	1580	9.2	0.25	0/10

*印は本発明の範囲外の試料を示す。

[0034] According to Table 1 and 2, by the cermet which distributed the coreless structure hard phase particle of 1 micrometer or less of mean particle diameters more than 1 volume % to the in-house, it turns out that deficit-proof nature and abrasion resistance are excellent.

[Translation done.]

PATENT ABSTRACTS OF JAPAN

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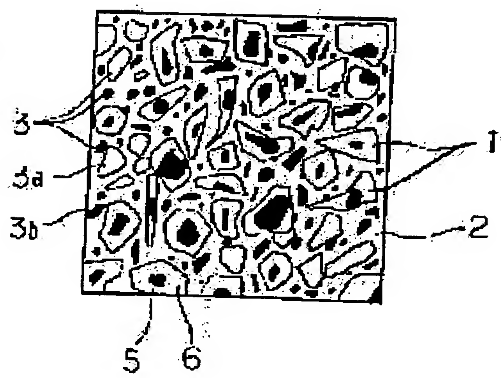
(21)Application number : 05-038691
(22)Date of filing : 26.02.1993

(71)Applicant : KYOCERA CORP
(72)Inventor : OHATA HIROSHI

(54) TICN BASED CERMET

(57)Abstract:
PURPOSE: To provide a TiCN based cermet having remarkably improved chipping resistance and wear resistance.
CONSTITUTION: The TiCN based cermet comprises the cored-structural hard phase grains 1 having a cored structure which consists of the core part 5 contg. Ti and N abundantly and the outer peripheral part 6 contg. W, Nb and C, the non cored-structural hard phase grains 3 not having any cored structure and the binding phase 2. Preferably in particular, of the total hard phase grains, the volume ratio of the non-cored-structural hard phase grains 3 having ·1μm crystalline grain size is ·1vol.% of the total, and the average crystalline grain size of the cored structural hard phase grains 1 is ·1μm, and also the average crystalline grain size of the non-cored-structural hard phase grains 3 is ·0.5μm.



LEGAL STATUS

[Date of request for examination]	22.07.1996
[Date of sending the examiner's decision of rejection]	11.01.2000
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's	

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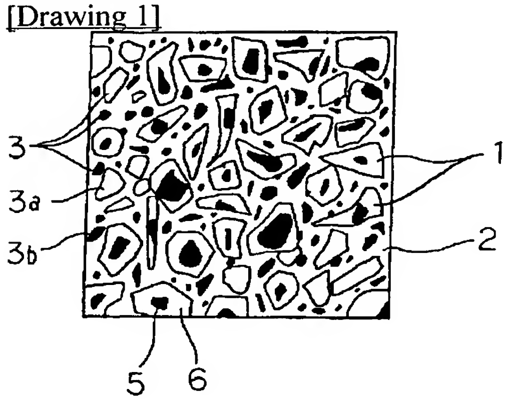
DRAWINGS

[Drawing 1]



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EXAMPLE

[Example] 1.5 ton/cm2 after carrying out weighing capacity mixture so that composition of the last sintered compact may grow into the rate of Table 1, using each powder of TiC, TiCN, and WC, NbC, nickel and Co as raw material powder Press forming was carried out to the chip configuration for CNMG120408 by the pressure, and at the temperature of 1500 degrees C, it was made to change from a degree of vacuum 10-1 to a degree of vacuum 10-3, and calcinated for 1 hour. A sintered-compact organization is shown in drawing 1 .
[0030]
[Table 1]

試料No.	組　成　（鉄族金属、不純物を除く）	鉄族金属(wt%)	
		Ni	Co
1	$(Ti_{0.95}Nb_{0.025}W_{0.025})(C_{0.50}N_{0.50})_{0.9}$	4	12
2	$(Ti_{0.90}Nb_{0.07}W_{0.03})(C_{0.55}N_{0.45})_{0.9}$	4	12
3	$(Ti_{0.85}Nb_{0.12}W_{0.03})(C_{0.45}N_{0.55})_{0.9}$	4	12
4	$(Ti_{0.80}Nb_{0.15}W_{0.05})(C_{0.50}N_{0.50})_{0.9}$	3	15
5	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.45}N_{0.55})_{0.9}$	4	12
*6	$(Ti_{0.85}Nb_{0.07}W_{0.08})(C_{0.55}N_{0.45})_{0.9}$	4	12
*7	$(Ti_{0.65}Nb_{0.15}W_{0.30})(C_{0.45}N_{0.55})_{0.9}$	4	12
*8	$(Ti_{0.50}Nb_{0.45}W_{0.05})(C_{0.55}N_{0.45})_{0.9}$	4	12
*9	$(Ti_{0.80}Nb_{0.03}W_{0.17})(C_{0.50}N_{0.50})_{0.9}$	4	12
*10	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.25}N_{0.75})_{0.9}$	4	12

＊印は、本発明の範囲外の試料を示す。

[0031] After carrying out polishing of the sample front face, it asked for the diameter of average crystal grain of the obtained sintered compact with SEM (scanning electron microscope) and the image processing system. Moreover, the diameter of crystal grain searched for the rate of a coreless structure hard phase particle 1 micrometer or less like measurement of the diameter of average crystal grain.
[0032] The cutting examination was performed by the cutting conditions shown in the following after processing, and cutting-ability ability was checked. The frank abrasion loss and the number of the corners non-suffering a loss in the flank after an examination were investigated.
(Abrasion test)
**-ed material SCN435 cutting speed 250 It cuts deeply m/min. 2 It sends mm. 0.3 mm/rev cutting time 10 min (deficit examination)

decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The cored structure hard phase particle which presents the cored structure which consists of a core part which is rich in Ti and N, and the periphery section containing W, Nb, and C, and the TiCN basis cermet characterized by the rate in which it is the TiCN basis cermet which consists of a coreless structure hard phase particle which is not, and a binder phase ****, and a coreless structure hard phase particle 1 micrometer or less occupies [the diameter of crystal grain] a cored structure among all hard phase particles being more than 1 volume %.
[Claim 2] The TiCN basis cermet according to claim 1 whose diameter of average crystal grain of a coreless structure hard phase particle the diameter of average crystal grain of a cored structure hard phase particle is 1 micrometers or more, and is 0.5 micrometers or less.
[Claim 3] other component composition except the iron-group metal from whole composition, and an unescapable impurity -- [(Ti) a (Nb) b (W) c] (Cu Nv) z **, when expressed a+b+c=1, 0.50<=a<=0.95, 0.05 <=b+c<=0.50, 0<b/b+c<=0.95, 0.40<=v<=0.60, 0.80<=z<=1.00, the TiCN basis cermet according to claim 1 or 2 with which are satisfied of u+v=1.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the TiCN basis cermet which is excellent in wet cutting-ability ability, when it uses especially as a cutting tool material about the TiCN basis cermet excellent in deficit-proof nature and abrasion resistance.
[0002]
[Description of the Prior Art] In recent years, the cermet constituted by the hard phase which becomes a cutting tool material, an antifriction tool material, etc. from the double charcoal nitride of periodic-table the 4a, 5a, and 6a group element, and the binder phase which consists of an iron-group metal came to be used widely.
[0003] Although the TiC basis cermet which makes TiC a principal component until now was in use as this cermet, since toughness was inferior as compared with the cemented carbide for which this TiC basis cermet was used as a tool material for many years, the so-called TiCN basis cermet which has improved toughness was proposed by adding a nitride in this system.
[0004] JP,56-51201,B is mentioned as an example of representation of this TiCN basis cermet, the cermet which consists of a hard phase which consists of CN (Ti, W, Ta, Mo), and a binder phase which consists of nickel and Co here is indicated, and it is said that the cored structure which consisted of a core part to which a hard phase is rich in Ti or nitrogen, and a periphery which is rich in W, Ta, Mo, and carbon is presented.
[0005] Moreover, the carbon (C) and nitrogen (N) which form a hard phase are a big factor which determines the toughness and degree of hardness of a cermet, and, recently, the attempt which is going to raise the toughness of a cermet is also made by making nitrogen contain so much.
[0006] However, improvement that abrasion resistance and toughness will be raised further is made by continuing till recently and changing the organization of the surface section to the above-mentioned TiCN basis cermet. for example, the thing for which the softening layer which is rich in toughness is formed in a sintering body surface in JP,59-14534,B by introducing nitrogen in a furnace below at liquid phase appearance temperature at the time of baking -- moreover, in JP,59-17176,B, forming the layer of a high degree of hardness from the interior is proposed by performing baking within the reducing atmosphere containing CO
[0007]
[Problem(s) to be Solved by the Invention] However, each of these advanced technology remained for examining either a degree of hardness or toughness, and was becoming inadequate for fulfilling service conditions which become severe every year, such as a service temperature, atmosphere, and a thermal shock. On the problem especially about a thermal shock and a mechanical shock, an injury arises while in use, and when the worst, a deficit is caused and a bird clapper is in use impotentia. This is considered to be because for the conventional cermet to be mainly inferior to a thermal shock resistance and deficit-proof nature compared with cemented carbide.
[0008]
[Means for Solving the Problem] As a result of inquiring to the above-mentioned trouble, by making a cermet in-house distribute the so-called coreless structure hard phase particle more than 1 volume %, this invention person did the knowledge of being [of a cermet] the thermal shock resistance, deficit-proof being nature, and abrasion resistance being further improvable, and resulted in this

particle containing Ti, N, and C.
[0014] Moreover, the diameter of average crystal grain of a cored structure hard phase particle was set to 1 micrometers or more, and the diameter of average crystal grain of a coreless structure hard phase particle was set to 0.5 micrometers or less because the particle which constitutes an organization would equalize and deficit-proof nature would fall, if the diameter of average crystal grain of a cored structure hard phase particle was smaller than 1 micrometer and the diameter of average crystal grain of a coreless structure hard phase particle was larger than 0.5 micrometers. As for the diameter of average crystal grain of the hard phase particle which especially the diameter of average crystal grain of the hard phase particle which presents a cored structure does not have **** in 1.2-3 micrometers and a cored structure, it is desirable to be referred to as 0.05-0.4 micrometers.
[0015] Moreover, Ti what [whose] was constituted as composition was mentioned above is a principal component which forms a hard phase exists in the sintering inside of the body as TiCN about, and the amount has become the big factor which determines the intensity and the degree of hardness of a cermet. When an antiwear characteristic is inadequate if there are few these amounts of Ti (a) in the aforementioned formula than 0.5, and 0.95 is exceeded, it is inferior to deficit-proof nature. As for the amount of Ti (a), it is desirable that it is especially 0.70<=a<=0.90.
[0016] In a cermet, W used as an indispensable component like Ti suppresses grain growth while improving wettability with the binder phase of a hard phase as WC, and although the operation which raises intensity and toughness is made, when a hard phase consists of CN(s) (Ti, W), there is a problem that properties, such as abrasion resistance, oxidation resistance, and deficit-proof nature, have not reached practical level. Then, although carbide, such as Mo and Ta, was used as an indispensable component for the purpose of strengthening a hard phase and improving many properties until now Since a property is inferior as compared with TiC or TiCN which is the Mo2 C itself and a hard phase principal component, depending on the case, it turns out that it does not contribute to improvement in a property of a cermet greatly conversely, but is in the inclination to degrade a property. Especially this inclination was remarkable under the operating environment accompanied by a thermal shock.
[0017] Then, by having the property in which the carbide of Nb was excellent in itself as a component replaced with Mo2 C as compared with Mo2 C, the property of a cermet, especially a thermal shock resistance can be improved greatly, and an antiwear characteristic and deficit-proof nature can be improved. Therefore, if there are few total amounts (b+c) of Nb and W in the composition of this invention than 0.05, a thermal shock resistance will become inadequate, and when larger than 0.5, while abrasion resistance is inferior, it is in the inclination for reactivity with **-ed material to become high. (b+c) As for a value, it is desirable that it is especially 0.10 <=b+c<=0.30.
[0018] moreover -- W -- Nb -- a total amount (b+c) -- receiving -- Nb -- an amount -- (-- b --) -- comparatively (b/b+c) -- zero -- it is -- ** -- abrasion resistance -- oxidation resistance -- deteriorating -- reverse -- 0.95 -- being large -- if -- deficit-proof nature -- falling . (b/b+c) As for a value, it is desirable that it is especially 0.3 <=b/b+c<=0.7.
[0019] According to the cermet in this invention, addition of Mo should be rather avoided from the reason for the above, and, as for the amount, it is desirable to carry out to 0.5 or less % of the weight among a cermet. the gas by decomposition of the nitride at the time of baking on the other hand although the amount of nitrogen and carbon is important as a factor which determines the degree of hardness of a cermet, a thermal shock resistance, and toughness and it is in the inclination which especially the amount of nitrogen increases and whose toughness is alike, and follows and improves, if the amount of nitrogen becomes excessive -- as a void -- sintering -- the problem of remaining inside of the body arises Therefore, when toughness will fall, deficit-proof nature will become inadequate, if nitrogen volume (v) is smaller than 0.4 in the aforementioned formula, and 0.6 is exceeded, a void occurs in the sintering inside of the body, and reliability comes to be missing. As for nitrogen volume (v), it is desirable that it is especially 0.4<=v<=0.55.
[0020] Moreover, if nitrogen and the ratio (z) to the total amount of Ti, W, and Nb of a carbon content are smaller than 0.8, a degree of sintering will deteriorate, a void will remain, and since free carbon will occur if larger than 1.0, a result which causes an on-the-strength fall is brought. It is 0.85<=z<=1.0 desirably.

invention.

[0009] That is, it is characterized by the cored structure hard phase particle which presents the cored structure which consists of a core part which is rich in Ti and N, and the periphery section containing W, Nb, and C, and the rate in which it is the TiCN basis cermet which consists of a coreless structure hard phase particle which is not, and a binder phase ****, and a coreless structure hard phase particle 1 micrometer or less occupies [the diameter of crystal grain] a cored structure among all hard phase particles being more than 1 volume %s. It is optimal that the diameter of average crystal grain of a cored structure hard phase particle is 1 micrometers or more, and the diameter of average crystal grain of a coreless structure hard phase particle is 0.5 micrometers or less here. Moreover, a composition top is [(Ti) a (Nb) b (W) c] (Cu Nv) z about other component composition except the iron-group metal from whole composition, and an unescapable impurity. When expressed, a+b+c=1, 0.50<=a<=0.95, 0.05 <=b+c<=0.50, 0<b/b+c<=0.95, 0.40<=v<=0.60, 0.80<=z<=1.00, and u+v=1 are satisfied.

[0010] Hereafter, this invention is explained in full detail.

[0011] Although the TiCN basis cermet of this invention consists of a hard phase and a binder phase fundamentally, it carries out distributed content of the coreless structure hard phase particle in this invention at a cermet in-house. That is, during the cermet organization, as shown in drawing 1 , the cored structure hard phase particle 1 of 1 micrometers or more of diameters of average crystal grain is distributing in a binder phase 2, and it has further structure which the coreless structure hard phase particle 3 of a particle distributed between the cored structure hard phase particles 1 of coarse grain.

[0012] And a coreless structure hard phase particle 1 micrometer or less contains [the diameter of crystal grain] at a rate more than 1 volume % among all hard phase particles. When fewer than 1 volume %, having made the rate for which the coreless structure hard phase particle of 1 micrometer or less of diameters of crystal grain accounts contain more than 1 volume % has few effects of strengthening of the binder phase by distribution of the coreless structure hard phase particle of a particle, and it is because neither abrasion resistance nor deficit-proof nature improves. As for the rate for which a coreless structure hard phase particle 1 micrometer or less accounts, it is desirable for the diameter of crystal grain to be below 50 volume %. When [than 50 volume %] more, it is to become the form where it is dotted with coarse grain, and for deficit-proof nature to fall into a particle. As for especially this coreless structure hard phase particle, it is desirable to do 2-5 volume % content of. What is necessary is just to do at least 1 volume % existence of the rate for which such a coreless structure hard phase particle accounts in the position from a cermet front face to a depth of 200 micrometers. Moreover, a coreless structure hard phase particle exists more mostly [a front face] than the interior of a cermet.

[0013] The cored structure hard phase particle consists of a core part 5 which is rich in Ti and N, and the periphery section 6 containing W, Nb, and C, as shown in drawing 1 . Moreover, W and Nb dissolve to Ti, C, and N particle, coreless structure hard phase particle 3a of drawing 1 expressed white is constituted, and coreless structure hard layer particle 3b of drawing 1 expressed blackly is a particle containing Ti, N, and C.

[0014] Moreover, the diameter of average crystal grain of a cored structure hard phase particle was set to 1 micrometers or more, and the diameter of average crystal grain of a coreless structure hard phase particle was set to 0.5 micrometers or less because the particle which constitutes an organization would equalize and deficit-proof nature would fall, if the diameter of average crystal grain of a cored structure hard phase particle was smaller than 1 micrometer and the diameter of average crystal grain of a coreless structure hard phase particle was larger than 0.5 micrometers. As for the diameter of average crystal grain of the hard phase particle which especially the diameter of average crystal grain of the hard phase particle which presents a cored structure does not have **** in 1.2-3 micrometers and a cored structure, it is desirable to be referred to as 0.05-0.4 micrometers.

[0015] Moreover, Ti what [whose] was constituted as composition was mentioned above is a principal component which forms a hard phase exists in the sintering inside of the body as TiCN about, and the amount has become the big factor which determines the intensity and the degree of hardness of a cermet. When an antiwear characteristic is inadequate if there are few these amounts of Ti (a) in the aforementioned formula than 0.5, and 0.95 is exceeded, it is inferior to deficit-proof nature. As for the amount of Ti (a), it is desirable that it is especially 0.70<=a<=0.90.

[0021] As an iron-group metal which forms a binder phase in this invention, nickel and/or Co are mentioned, it consists of nickel and Co desirably, and it is good from the point of wear-resistant improvement that especially the mole ratios of Co/nickel+Co are 0.5-0.9. Moreover, as for especially this iron-group metal, it is desirable for 3 - 30 % of the weight to exist at 5 - 20% of the weight of a rate in a system.
[0022] After carrying out weighing capacity mixture so that it may grow into the rate in which the last sintered compact mentioned above the powder and iron-group metal powder of the carbide of Ti, W, and Nb first mentioned above, a nitride, and a charcoal nitride as a method for manufacturing the cermet of the above-mentioned this invention, for example, it calcinates after fabrication with forming meanses, such as press forming, extrusion molding, and injection molding.
[0023] Baking is performed at the temperature of 1400-2000 degrees C in a vacuum or a reducing atmosphere. In the arbitrary temperature under sintering, 0-760Torr introduction of the gas, such as N, CO, Ar, and helium, may be carried out, and atmosphere adjustment may be performed.
[0024] Moreover, carbonization of Zr, Hf, Cr, Ta, V, etc., a nitride, a charcoal nitride, etc. are further added in order to improve a property to the system which consists of the above (Ti, W, Nb) (C, N) and an iron-group metal according to this invention. An improvement of a property can be aimed at by replacing a part of Ti or Nb, and when the operation effect of Nb is promoted further and it uses especially as a cutting tool by replacing a part of especially Nb by V, the wet cutting ability of a cermet can be improved greatly. In addition, as for the atomic ratio of Nb/V, it is desirable 0.5-10, and that it is especially 1-6.
[0025] The TiCN basis cermet of this invention may form the hard enveloping layer of a monolayer or a double layer by the well-known method further. As a hard enveloping layer covered, there are the carbide of one sort or two sorts or more of metals chosen from periodic-table the 4a, 5a, 6a group element and boron (B), and aluminum (aluminum), a nitride, a charcoal nitride, an oxide, a carbonation object, an acid nitride, and a carbonic acid nitride, and these are formed of CVD or PVD by the thickness of 0.1-10 micrometers. Thus, when it becomes possible to improve and abrasion resistance and deficit-proof nature are used as a tool by covering a front face with a specific material, a performance can be improved sharply.

[Translation done.]

[0016] In a cermet, W used as an indispensable component like Ti suppresses grain growth while improving wettability with the binder phase of a hard phase as WC, and although the operation which raises intensity and toughness is made, when a hard phase consists of CN(s) (Ti, W), there is a problem that properties, such as abrasion resistance, oxidation resistance, and deficit-proof nature, have not reached practical level. Then, although carbide, such as Mo and Ta, was used as an indispensable component for the purpose of strengthening a hard phase and improving many properties until now Since a property is inferior as compared with TiC or TiCN which is the Mo2 C itself and a hard phase principal component, depending on the case, it turns out that it does not contribute to improvement in a property of a cermet greatly conversely, but is in the inclination to degrade a property. Especially this inclination was remarkable under the operating environment accompanied by a thermal shock.

[0017] Then, by having the property in which the carbide of Nb was excellent in itself as a component replaced with Mo2 C as compared with Mo2 C, the property of a cermet, especially a thermal shock resistance can be improved greatly, and an antiwear characteristic and deficit-proof nature can be improved. Therefore, if there are few total amounts (b+c) of Nb and W in the composition of this invention than 0.05, a thermal shock resistance will become inadequate, and when larger than 0.5, while abrasion resistance is inferior, it is in the inclination for reactivity with **-ed material to become high. (b+c) As for a value, it is desirable that it is especially 0.10 <=b+c<=0.30.

[0018] moreover -- W -- Nb -- a total amount (b+c) -- receiving -- Nb -- an amount -- (-- b --) -- comparatively (b/b+c) -- zero -- it is -- ** -- abrasion resistance -- oxidation resistance -- deteriorating -- reverse -- 0.95 -- being large -- if -- deficit-proof nature -- falling . (b/b+c) As for a value, it is desirable that it is especially 0.3 <=b/b+c<=0.7.

[0019] According to the cermet in this invention, addition of Mo should be rather avoided from the reason for the above, and, as for the amount, it is desirable to carry out to 0.5 or less % of the weight among a cermet. the gas by decomposition of the nitride at the time of baking on the other hand although the amount of nitrogen and carbon is important as a factor which determines the degree of hardness of a cermet, a thermal shock resistance, and toughness and it is in the inclination which especially the amount of nitrogen increases and whose toughness is alike, and follows and improves, if the amount of nitrogen becomes excessive -- as a void -- sintering -- the problem of remaining inside of the body arises Therefore, when toughness will fall, deficit-proof nature will become inadequate, if nitrogen volume (v) is smaller than 0.4 in the aforementioned formula, and 0.6 is exceeded, a void occurs in the sintering inside of the body, and reliability comes to be missing. As for nitrogen volume (v), it is desirable that it is especially 0.4<=v<=0.55.

[0020] Moreover, if nitrogen and the ratio (z) to the total amount of Ti, W, and Nb of a carbon content are smaller than 0.8, a degree of sintering will deteriorate, a void will remain, and since free carbon will occur if larger than 1.0, a result which causes an on-the-strength fall is brought. It is 0.85<=z<=1.0 desirably.

[0021] As an iron-group metal which forms a binder phase in this invention, nickel and/or Co are mentioned, it consists of nickel and Co desirably, and it is good from the point of wear-resistant improvement that especially the mole ratios of Co/nickel+Co are 0.5-0.9. Moreover, as for especially this iron-group metal, it is desirable for 3 - 30 % of the weight to exist at 5 - 20% of the weight of a rate in a system.

[0022] After carrying out weighing capacity mixture so that it may grow into the rate in which the last sintered compact mentioned above the powder and iron-group metal powder of the carbide of Ti, W, and Nb first mentioned above, a nitride, and a charcoal nitride as a method for manufacturing the cermet of the above-mentioned this invention, for example, it calcinates after fabrication with forming meanses, such as press forming, extrusion molding, and injection molding.

[0023] Baking is performed at the temperature of 1400-2000 degrees C in a vacuum or a reducing atmosphere. In the arbitrary temperature under sintering, 0-760Torr introduction of the gas, such as N, CO, Ar, and helium, may be carried out, and atmosphere adjustment may be performed.

[0024] Moreover, carbonization of Zr, Hf, Cr, Ta, V, etc., a nitride, a charcoal nitride, etc. are further added in order to improve a property to the system which consists of the above (Ti, W, Nb) (C, N) and an iron-group metal according to this invention. An improvement of a property can be aimed at

by replacing a part of Ti or Nb, and when the operation effect of Nb is promoted further and it uses especially as a cutting tool by replacing a part of especially Nb by V, the wet cutting ability of a cermet can be improved greatly. In addition, as for the atomic ratio of Nb/V, it is desirable 0.5-10, and that it is especially 1-6.
[0025] The TiCN basis cermet of this invention may form the hard enveloping layer of a monolayer or a double layer by the well-known method further. As a hard enveloping layer covered, there are the carbide of one sort or two sorts or more of metals chosen from periodic-table the 4a, 5a, 6a group element and boron (B), and aluminum (aluminum), a nitride, a charcoal nitride, an oxide, a carbonation object, an acid nitride, and a carbonic acid nitride, and these are formed of CVD or PVD by the thickness of 0.1-10 micrometers. Thus, when it becomes possible to improve and abrasion resistance and deficit-proof nature are used as a tool by covering a front face with a specific material, a performance can be improved sharply.
[0026]
[Function] In the TiCN basis cermet of this invention, the cored structure hard phase particle is distributing in a binder phase, since the diameter of crystal grain has further structure which the coreless structure hard phase particle of a particle 1 micrometer or less distributed more than 1 volume % between the cored structure hard phase particles of coarse grain, a binder phase is strengthened and deficit-proof nature improves.
[0027] Moreover, it becomes possible by setting the diameter of average crystal grain of a cored structure hard phase particle to 1 micrometers or more, and setting the diameter of average crystal grain of a coreless structure hard phase particle to 0.5 micrometers or less to improve deficit-proof nature and abrasion resistance still more sharply.
[0028] Hereafter, the following example explains this invention.
[0029]
[Example] 1.5 ton/cm2 after carrying out weighing capacity mixture so that composition of the last sintered compact may grow into the rate of Table 1, using each powder of TiC, TiCN, and WC, NbC, nickel and Co as raw material powder Press forming was carried out to the chip configuration for CNMG120408 by the pressure, and at the temperature of 1500 degrees C, it was made to change from a degree of vacuum 10-1 to a degree of vacuum 10-3, and calcinated for 1 hour. A sintered-compact organization is shown in drawing 1 .
[0030]
[Table 1]

試料No.	組　成　（鉄族金属、不純物を除く）	鉄族金属(wt%)	
		Ni	Co
1	$(Ti_{0.95}Nb_{0.025}W_{0.025})(C_{0.50}N_{0.50})_{0.9}$	4	12
2	$(Ti_{0.90}Nb_{0.07}W_{0.03})(C_{0.55}N_{0.45})_{0.9}$	4	12
3	$(Ti_{0.85}Nb_{0.12}W_{0.03})(C_{0.45}N_{0.55})_{0.9}$	4	12
4	$(Ti_{0.80}Nb_{0.15}W_{0.05})(C_{0.50}N_{0.50})_{0.9}$	3	15
5	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.45}N_{0.55})_{0.9}$	4	12
*6	$(Ti_{0.85}Nb_{0.07}W_{0.08})(C_{0.55}N_{0.45})_{0.9}$	4	12
*7	$(Ti_{0.55}Nb_{0.15}W_{0.30})(C_{0.45}N_{0.55})_{0.9}$	4	12
*8	$(Ti_{0.50}Nb_{0.45}W_{0.05})(C_{0.55}N_{0.45})_{0.9}$	4	12
*9	$(Ti_{0.80}Nb_{0.03}W_{0.17})(C_{0.50}N_{0.50})_{0.9}$	4	12
*10	$(Ti_{0.80}Nb_{0.10}W_{0.10})(C_{0.25}N_{0.75})_{0.9}$	4	12

＊印は、本発明の範囲外の試料を示す。

[0031] After carrying out polishing of the sample front face, it asked for the diameter of average crystal grain of the obtained sintered compact with SEM (scanning electron microscope) and the image processing system. Moreover, the diameter of crystal grain searched for the rate of a coreless structure hard phase particle 1 micrometer or less like measurement of the diameter of average crystal grain.
[0032] The cutting examination was performed by the cutting conditions shown in the following after processing, and cutting-ability ability was checked. The frank abrasion loss and the number of the corners non-suffering a loss in the flank after an examination were investigated.
(Abrasion test)
**-ed material SCN435 cutting speed 250 It cuts deeply m/min. 2 It sends mm. 0.3 mm/rev cutting time 10 min (deficit examination)
**-ed material SCN435 (4 slot ON)
Cutting speed 100 It cuts deeply m/min. 2 It sends mm. 0.3 mm/rev cutting time 1 The min characterization result was shown in Table 2.
[0033]
[Table 2]

試料No.	結晶粒径1μm以下の非有芯構造粒子(体積%)	有芯構造粒子の平均結晶粒径(μm)	非有芯構造粒子の平均結晶粒径(μm)	強度(kg/mm²)	硬度(kg/mm²)	靱性(MPa・m$^{1/2}$)	切削試験	
							摩耗量(mm)	耐欠損性
1	3	1.8	0.2	1820	1400	14.0	0.16	9/10
2	2	2.5	0.2	1750	1460	13.0	0.12	10/10
3	5	1.0	0.2	1770	1450	13.5	0.18	10/10
4	3	2.0	0.15	1790	1510	13.0	0.15	9/10
5	1	1.5	0.50	1800	1420	13.8	0.18	10/10
*6	0.1以下	3.0	1.5	1620	1410	13.1	0.30	2/10
*7	0	2.0	——	1400	1250	13.5	0.41	1/10
*8	0	3.5	——	1350	1210	12.5	損傷大	0/10
*9	0.3	2.5	2.0	1600	1510	10.5	0.28	2/10
*10	0	0.9	——	1700	1580	9.2	0.25	0/10

*印は本発明の範囲外の試料を示す。

[0034] According to Table 1 and 2, by the cermet which distributed the coreless structure hard phase particle of 1 micrometer or less of mean particle diameters more than 1 volume % to the in-house, it turns out that deficit-proof nature and abrasion resistance are excellent.
[0035]
[Effect of the Invention] In the TiCN basis cermet of this invention, since the coreless structure hard phase particle was contained more than 1 volume %, while expanding the cutting conditions which can be applied when it can improve sharply and this uses deficit-proof nature and abrasion resistance as a tool, reinforcement of a tool can be attained.

[Translation done.]